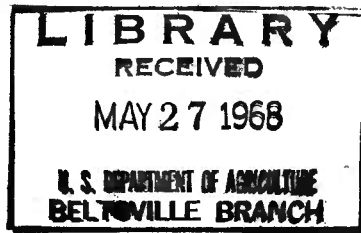


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Strawberry Culture:

**EASTERN
UNITED
STATES**

Farmers' Bulletin No. 1028



U.S. DEPARTMENT OF AGRICULTURE

Strawberry Culture:

Eastern United States



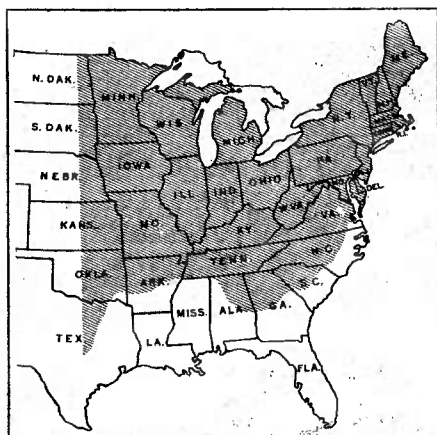
Prepared by Crops Research Division, Agricultural Research Service

Strawberries are an important crop in the eastern United States. This bulletin recommends growing methods for that part of the East bounded by the Great Plains on the west and by the Coastal Plain on the south (fig. 1).

Strawberries produce well in most of the region, but favorable

growing conditions do not ensure success; economic conditions must also be favorable. Before you decide to grow strawberries on a commercial basis, consider these factors:

- Labor. Is it possible to obtain workers when they are needed?
- Market. Is there a dependable market outlet?
- Transportation. Is there an all-weather market road, and are vehicles available for hauling the crop?



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Figure 1.—The regions to which this bulletin applies are indicated by shading.

HOW THE PLANTS GROW

Healthy dormant plants set in moist soil in early spring produce new roots in a few days. In a few more days each plant usually has several new leaves of normal size.

Beginning in June, and continuing into early fall, runners emerge where the leaves join the main stems. These runners grow outward, form new plants, and take

root several inches from the original plant (fig. 2). New runners grow from the new plants, and in this way a succession of independent new plants are soon growing around the original plant.

Plants produce flowers the first year, and the flowers will develop into fruit if they are not pinched off. Usually, the flowers are pinched off so that the plant itself will develop, grow vigorously, and be capable of producing a good fruit crop the next spring.

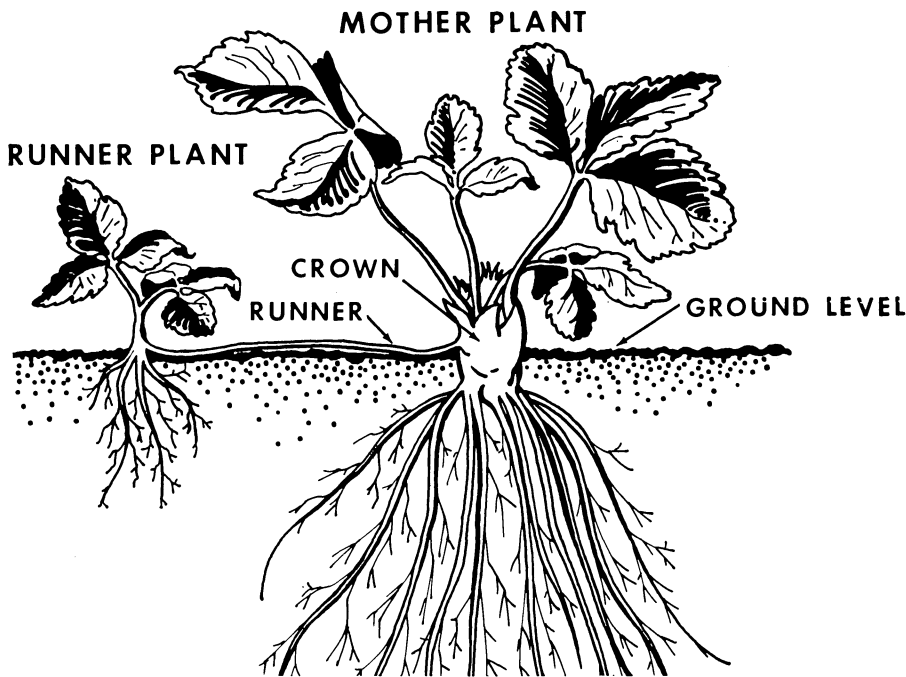
In the fall, the growing points in the crown change into flower buds. This happens about September 1 in early varieties, and from about September 20 to about October 10 in late varieties. The buds grow rapidly, and by the end of October they

can readily be seen by opening the crowns. In vigorous plants, buds also develop in many of the leaf axils.

The number of leaves on a plant in the fall is an indication of the following year's production: the more leaves, the more berries the plant will produce the next spring.

Plants become dormant after the days become short and cool. All the older green leaves die, and so do the connecting runners.

In the spring of the fruiting year the flower buds renew growth and develop into flowers. The first flower to open on a cluster contains the most pistils (female elements), is the largest, and becomes the largest fruit with the most seeds. The next flower to open becomes the next



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Figure 2.—Strawberry plants produce runners, which take root and form new plants.

largest fruit, and later flowers become successively smaller fruits.

Strawberries mature in about 30 days after blooming in mild weather. In warm weather they mature more rapidly.

SUITABLE SITES

Location

In selecting a site for a strawberry planting, consider air and water drainage, land slope, and direction of land exposure.

If late spring frosts are frequent in your locality, choose a site on ground slightly higher than the surrounding areas. There is less danger of frost damage on the high ground, because cold air drains to the adjoining low ground.

Ordinarily, a site that slopes gradually is preferable to one that slopes steeply, since a gradual slope is less liable to soil runoff.

Select a site that slopes toward the south if you want the crop to ripen as early as possible; select one that slopes to the north if you want to delay ripening. Strawberries on southern slopes ripen several days sooner than those on northern slopes.

Soil Requirements

Strawberries may be grown successfully on almost any type of soil that contains a good supply of organic matter. Growers wishing to produce early fruit usually prefer sandy soil.

Strawberries thrive in well-drained soil that is moist but not wet. Plants are liable to be killed when wet ground freezes in the

winter, especially if the soil is clay or fine sandy silt. Wet soil inhibits plant growth and may lead to damage by red-stele root rot.

TRAINING SYSTEMS

Three training systems are commonly used:

- Hill system—no runners are allowed to grow.
- Spaced matted-row system—some runners are allowed to grow.
- Matted-row system—most runners are allowed to grow.

The hill system and the spaced matted-row system are recommended for use with irrigation and in intensive cultivation. The hill system is not recommended where there is danger from white grubs, drought, or severe winters. Where these dangers exist, use the matted-row system. Hill system plantings are most often used for home gardens.

Hill System

In the hill system, plantings are made either in double or triple rows, with the plants 10 to 12 inches apart in the rows, and with 12 inches between adjoining rows. A 24-inch alley is left between each group of rows. Figure 3 illustrates the double-row hill system, in which 29,000 plants are set per acre. Figure 4 illustrates the triple-row hill system, in which 32,670 plants are set per acre.

Spaced Matted-Row System

In the spaced matted-row system, set the plants 18 to 24 inches apart in the rows. Leave a 42-inch space between the rows. Planting an

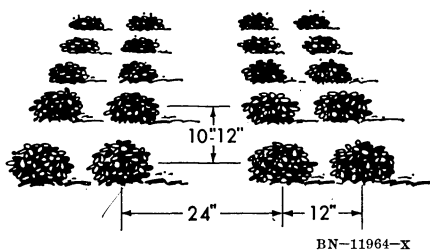


Figure 3.—In the double-row hill system, a 24-inch alley separates rows that are 12 inches apart. Plants in the rows are 10 to 12 inches apart.

acre under this system requires 6,225 plants if the 24-inch spacing is used, or 8,300 plants if the 18-inch spacing is used.

Matted-Row System

Spacing for the matted-row system is the same as for the spaced matted-row system.

Because there is no runner placement, and less weed-control work, growing strawberries in matted rows costs less per acre than growing them in spaced matted rows.

Under the matted-row system individual plants are apt to be crowded, and because of crowding, yields and individual fruit size may be smaller than under the spaced matted-row system.

VARIETIES

The selection of varieties to plant depends on climate, soil, and the purpose for which the crop is to be grown.

Some special-purpose varieties bear firm berries especially suited to long-distance shipment. Others have large attractive berries of the best quality, but their texture is too soft for long-distance shipment.

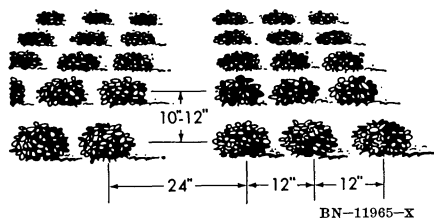


Figure 4.—Planting in the triple-row hill system is the same as for the double-row hill system (see fig. 3) with one exception: There are three rows between alleys instead of two.

Still other varieties have a bright-red, firm flesh and a tart flavor; these are suitable for freezing and are also sold to dealers who supply the soda-fountain trade.

Select varieties that will ripen when the market demand is good and when competition from other localities is low (fig. 5).

If spring frosts are apt to injure crops in your area, select late-blossoming varieties and those least susceptible to frost injury.

For the home garden, grow early, medium, and late varieties to provide fruit through a long season.

If you plan to grow strawberries for the wholesale market, select varieties that are well known; they command higher prices. Buyers prefer full truckloads or carloads of one variety or—at least—of varieties that are similar in color, shape, flavor, and shipping quality.

It may be a good plan to grow two or three varieties that have different blossoming times: if frosts occur, one variety may be much less injured than the others.

If you plan to grow the crop for a local market, select three or four varieties to supply the market in the

very early, medium early, mid-season, and late ripening periods.

For a more complete discussion of varieties, see Farmers' Bulletin 1043, "Strawberry Varieties in the United States."

OBTAINING PLANTING STOCK

Young plants for starting a plantation are usually obtained from commercial nurseries. Make an effort to get disease-free and nematode-free planting stock.

It is usually easier to get nursery-grown plants in the spring than in other seasons.

If you have an established plantation, you can get planting stock from it. In very early spring select and transplant the most vigorous of the young plants that are growing alongside the bearing rows. Choose these plants from plantings

that are free from diseases and insect infestations. This practice is not recommended if the plantation is growing on clay, because the roots are not strongly developed when grown on clay and usually break when moving is attempted.

CARE OF PLANTING STOCK

There are usually only one or two young leaves on each plant when it is received from the nursery. Remove all but one small leaf.

The roots should be fresh and bright. Roots of healthy plants grown on muck soils are dark; roots of healthy plants grown on other soils are white or yellowish. Plants in good condition for setting are shown in figure 6.

If plants received from the nursery cannot be set for several days, they should be kept in cold storage or they may be heeled in.

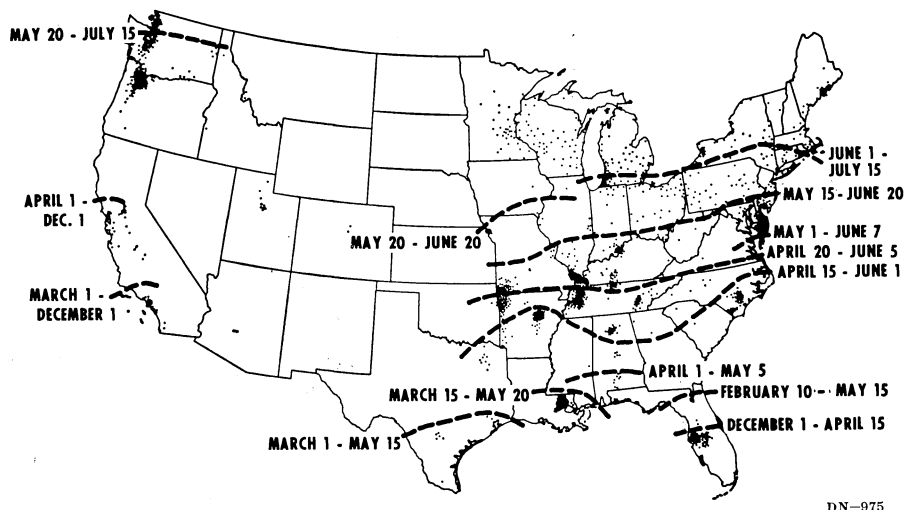


Figure 5.—Map showing the location of principal commercial strawberry-producing regions, the approximate ripening time in each region, and the northward progression of the strawberry season.

Cold Storage

If the plants are not fully dormant when they arrive from the nursery, keep them at 40° to 42° F. for a few days or at 32° to 36° for a longer period. If they are received in a fully dormant state, store them at 30° to 32°.

Before storing the plants, wrap them in polyethylene film to prevent them from drying out.

The plants may be kept in a refrigerator if desired.

Heeling In

If the plant roots are very dry, soak them in water for several hours before heeling in. Heel them in individually in a V-shaped trench deep enough for the roots to spread out when the crowns are at ground level. Lay the plants along one of

the sloping edges of the trench. Space them so that the roots of adjacent plants will not get tangled. Pack the soil firmly about the roots, and leave the plants heeled in until they are wanted in the field. Placement of plants in a trench is diagrammed in figure 7.

If the plants are extremely dry when received, let them start a new root system while they are heeled in. When you remove these plants from the trench, take extra care to avoid damaging the tender young roots.

PREPARING THE SOIL

Strawberries grow best in well-prepared soil that is high in organic matter.

If culture of the previous crop included thorough seedbed prepa-



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Figure 6.—Plants in good condition for setting.

ration, cultivation, and either turning under green manure or adding stable manure, only harrowing is needed to prepare the soil for planting.

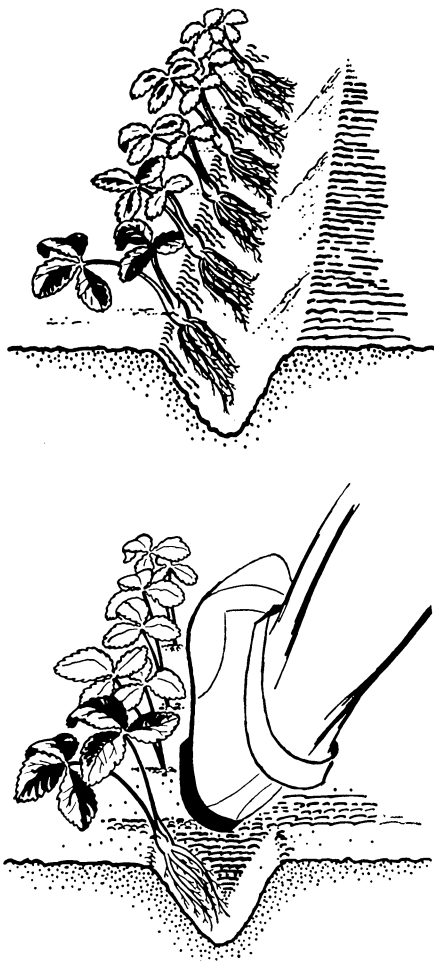
If culture during the previous year or two has not included these practices, at least 1 year of special preparation will be needed for best results.

If the soil lacks organic matter, plant a green-manure crop, or apply stable manure. If the soil is very deficient in organic matter you may need to plant at least two green-manure crops before it is ready for planting strawberries. Ordinarily, one crop of crimson clover—or rye and vetch—is sufficient. Where these cannot be grown successfully, substitute cowpeas, Canada peas, buckwheat, Sudan grass, or some other commonly grown green-manure crop.

Use the cover crop best suited to your location and fertilize it heavily to obtain rank growth and an abundance of green manure.

Sufficient organic matter may be supplied during the year previous to planting strawberries by (1) applying a large quantity of stable manure on a crop such as sweetpotatoes or tobacco, and (2) following with a green-manure crop.

On sandy soils damage from strawberry root aphids is a hazard. Damage is particularly serious in the States along the Atlantic Coast and is often serious in the central part of the region. Losses are much greater when the strawberry planting follows corn, grass, or



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Figure 7.—To heel in plants, place them in a trench with the crown at ground level (top), and firmly pack soil about the roots (bottom).

weeds, because then the ants that carry the aphids from plant to plant are usually abundant. There are generally few ants, however, following crops of sweetpotatoes or tobacco. Either plant strawberries after one of these crops, or control the ants in accordance with recommendations of your State agricultural experiment station.

Do not plant strawberries on newly plowed sod unless the land has been treated for white grubs. White grubs are very destructive to strawberries planted on infested soil. Where white grubs are a serious problem, either use chlordane, aldrin, or dieldrin on the freshly plowed land, or plant the field to cultivated crops for at least two seasons. Where they are a minor problem, plowing the soil in the autumn will allow winter cold to kill many of them and give adequate control.

Also, it is generally not advisable to plant strawberries in a field where persistent weeds—like quackgrass, purslane, and chickweed—are abundant. In eastern Virginia, in parts of Tennessee, and in Arkansas the strawberry dwarf disease, caused by a bud nematode, is a serious threat. Avoid planting in infested soil for at least 2 years.

For further information on the nematode problem, see USDA Farmers' Bulletin 2140, "Strawberry Diseases."

Under most conditions, strawberries are grown on level ground. However, where the hill system is used, or if surface drainage is poor, they are grown on raised beds or ridges. A raised bed on which to set the plants may be made by throwing two or more furrows together and leveling with a plank drag. Ordinarily the bed should be 2 or 3 inches high; it may be higher if drainage is very poor. Pulverize the soil thoroughly just before setting the strawberry

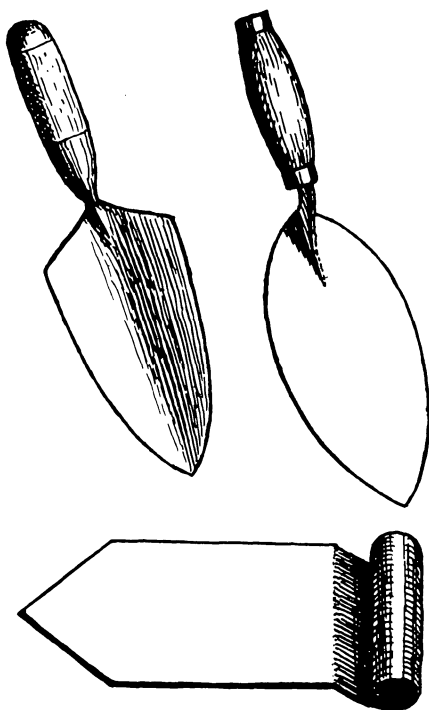
plants. If the soil is plowed in the autumn, a thorough harrowing in the spring will be sufficient.

PLANTING

Season

Temperature and moisture conditions for planting are usually best in early spring, and most strawberry planting is done then.

Late-set plants, unless they have been kept in cold storage, do not grow as well as early-set plants. Furthermore, the average yield from plants set in late summer will not be as large as from plants set in the spring.



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Figure 8.—Two types of trowels commonly used for planting strawberries. The type shown at top is best for most conditions.

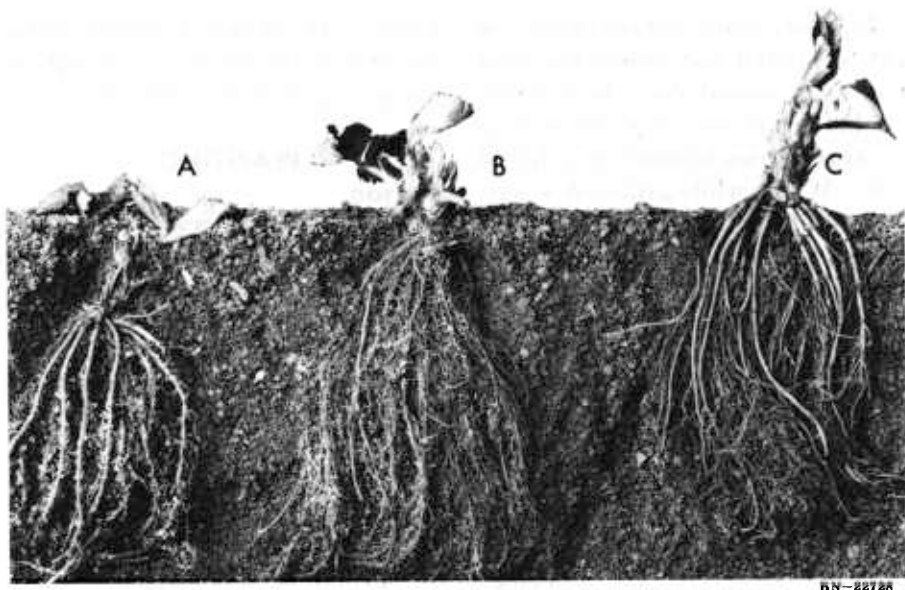


Figure 9.—Plants set at different depths: A, Plant set too deep; B, plant set at correct depth; C, plant set too shallow.

Where the land must be fully utilized and rainfall is dependable, however, plants of those varieties that bud in late fall and early spring—such as Pocahontas and Albritton—are set in late summer to bear the following year. If plants are set at this time, plow a large quantity of strawy manure into the soil before planting. Later a fall mulch of strawy manure should be applied.

If the season is very dry or very wet, or if a winter mulch is not used, the plants set in the autumn will be killed by low winter temperatures. On very heavy soils, if early autumn planting is necessary, be sure to protect the plants by a mulch in winter. On such soils, it is preferable to plant in late spring with dormant cold-storage plants.

Plants for autumn setting must be large and should have good root

systems. They must be set in moist soil. Irrigation is usually necessary for autumn-set plants to get a strong start.

Methods

Whether plants are set by hand or by machine, it is important to—

- Keep the plants moist before setting.
- Set them at the correct depth.
- Make the soil firm around the plant roots.

For ease in planting, the ends of long roots may be cut back without harming the plants, but general root pruning is not recommended.

A trowel, dibble, or other suitable tool often is used to make holes for setting a small number of plants by hand (fig. 8).

Set the plants at correct depth, with the crown just below ground level (fig. 9). Plants set too deep

are likely to smother and die. Plants set too shallow will dry out.

Pack the soil around the roots of the plants by stepping on each plant; place the instep over the crown of the plant and step firmly.

For more extensive plantings, the same sequence of operations is followed, but one man makes the holes, another drops the plants in them, and a third firms the soil around the plant roots.

Another common method of handsetting strawberries requires a two-man crew. One man inserts a spade in the soil and forces it forward. While he holds the spade in position, the other man places a plant in the hole. The first man then withdraws the spade and firms the soil around the plant roots with his foot.

When setting plants by hand, protect them from drying by carrying them in a basket, bucket, or sack.

Planting machines are used for setting strawberries on plantations of 2 acres or more. A skilled crew can machine set 3 to 5 acres a day.

CARE OF THE PLANTATION

Cultivating

Use the cultivator as often as once a week during the first season to control weeds. Hoe as often as necessary to clean out weeds between the plants.

Hoe and cultivate toward the plants. This keeps the roots from being killed by exposure to the air. Keep the crowns of the plants at ground level at all times. Set the

teeth on each side of the cultivator so they will not stir the soil more than 1 or 2 inches deep near the rows. This prevents loosening the plants or cutting their roots.

It is not possible to cultivate a field after it is mulched in the fall; so, if you are going to use mulch, continue to cultivate until you apply it.

Ordinarily, no cultivating is done in the spring of the fruiting year. If the field chosen for the plantation is not heavily infested with weeds, and if recommendations for cultivation, chemical weed control, and mulching are followed the first year, weeds should not be a serious problem before the crop is picked.

If the plantation is renewed, cultivate and hoe as you would for a newly set field.



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Figure 10.—Removing flowers the first season helps the plant to make vigorous vegetative growth.

Removing Flowers

Culture of newly set strawberry plants should aim for vigorous growth rather than flowering or bearing. During the first season, remove flower stems on the plants as soon as they appear (fig. 10). This strengthens the plant and also increases the number of runner plants. This is an advantage because early-formed runner plants bear the most fruit the following year.

Thinning and Spacing

HILL SYSTEM.—Under the hill system, whenever runner plants appear throughout the first summer, cut them off. Use a hoe or a cutter made for the purpose. If the soil is free from stones and straw, cut the runners with two rolling colters attached to the cultivator, set to run between the rows.

SPACED MATTED-ROW SYSTEM.—Under the spaced matted-row system, train the runners by hand so that runner plants are 6 to 8 inches apart (fig. 11). Establish plants in the desired position by covering the tips of the runners with soil as soon as they begin to enlarge. The plant bed should be 18 to 24 inches wide, with about 24 inches of alley between rows. This spacing is retained in thinning.

MATTED-ROW SYSTEM.—Under the matted-row system, allow all runners to root until early fall. The beds formed usually have 2 to 3 inches between plants. Keep the beds 18 to 24 inches wide, with alleys about 24 inches wide between

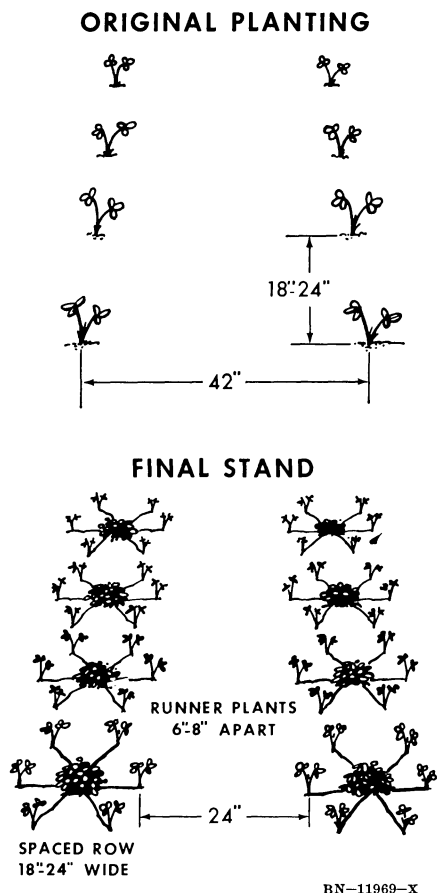


Figure 11.—In the spaced matted-row system, plants are set 18 to 24 inches apart in rows 42 inches apart (top). The runner plants that are allowed to develop are placed in desired positions; in the final stand, plants are 6 to 8 inches apart in rows 18 to 24 inches wide.

the rows. Use rolling colters on a cultivator, set to cut all runners that extend into the alleys after the desired stand of plants has been obtained.

During late summer or autumn, thin the plants to 3 or 4 inches between each plant. Remove surplus runners when you hoe the

plantation. You may run a spike-toothed harrow—with teeth set to slant backward—across the rows to thin them; but be careful not to loosen too many plants with the harrow.

Mulching

Mulching protects the plantation against plant losses caused by low temperatures and by soil heaving that may result from freezing and thawing.

Mulching also helps to keep down weeds, to keep the berries clean, and to conserve moisture.

Small-grain straws and marsh hay are the best mulching materials. Other satisfactory materials are pine needles, ferns, strawy stable manure, hay, Sudan grass, mixtures of kafir and sorghum fodders, and mixtures of spring oats, straw, and sorghum fodder. If Sudan grass, kafir, or sorghum is used, it should first be run through a hay crusher. Crushing allows the material to dry rapidly and therefore reduces the risk of moldy or rotten mulch.

Mechanical application of mulch saves time and labor (fig. 12).

Fertilizing

Strawberry plants that are growing vigorously and have dark-green leaves throughout the summer probably have an adequate supply of fertilizer.

Use fertilizers only when a soil test or poor plant growth shows that they are needed.

Applying fertilizer to the fruiting crop is not normally recom-

mended; it is best to apply it the year the plants are set. If the plantation is renewed, fertilizer may be applied during the renewal operation.

Liming

Liming the soil provides calcium and, if the lime is in the form of dolomite, magnesium as well. Liming also decreases soil acidity.

Strawberries grow well in soil that has an acidity (pH) range of 5.7 to 6.5. They may grow well in soil of pH 5.0 to 7.0 (neutral acidity) if the soil is high in organic matter. Soil that measures pH 5.3 or less should be limed.

Have your soil tested to determine how much lime is needed. Do not apply more than is recommended; too much lime reduces the size of the plants and fruit.

Lime should be applied to previous crops. If it is not possible to apply lime a year or two before planting strawberries, apply it and work it into the soil thoroughly before the strawberry plants are set.

Irrigating

Irrigating strawberry plantings is especially beneficial if there is dry weather either in the summer when the plants are getting established, or in the spring from blossomtime through the fruiting season.

Sprinkler or surface irrigating systems may be used on strawberry plantations.

The most common sprinkler irrigation systems consist of 4-inch

portable aluminum pipes with 3-inch pipes attached to them laterally. The rotating sprinkler heads are mounted at 40-foot intervals on the lateral pipes. About 1,100 feet of lateral 3-inch pipe is needed per acre.

For commercial plantations of $\frac{1}{4}$ acre or less, or for home gardens, use an eyelet hose sprinkler system. This is a flat plastic tube having small holes spaced along its upper side. With suitable pressure, an eyelet hose will irrigate 3 or 4 rows at a time.

Furrow irrigation, a form of surface application, is used where the land has sufficient slope to let the water flow slowly down the furrows.

The soil must be of a fairly heavy texture so that the irrigation water will flow the full length of the furrows, which should not be more than 200 to 250 feet long.

For sandy soils with a gentle slope, a porous canvas hose may be

useful. However, only one or two rows can be irrigated at one setting of the hose.

PROTECTING AGAINST WINTERKILL

In the autumn the strawberry plants gradually become hardier and by winter they can stand normal winter temperatures. However, if a sudden cold snap with temperatures lower than about 20° F. occurs before the plants harden, they may be severely damaged. Temperatures of 15° or lower may kill unhardened plants.

Plants may also be killed if alternate freezing and thawing of soil heaves the plants out of the ground or breaks their roots.

Mulching protects strawberry plantations against low temperatures and against rapid alternate freezing and thawing.

Ordinarily, as soon as a temperature of 20° F. or lower has occurred, the strawberry plants will



Figure 12.—Applying mulch by machine.

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have become hardened, and the mulch should be applied. Recommended mulching dates are shown in figure 13.

In the upper Mississippi Valley area, about 6 tons of mulch per acre are required; elsewhere, 2 to 2½ tons are sufficient.

Rake all but a light covering of mulch into the alleys between the rows as soon as the plants begin to grow in the spring.

PROTECTING AGAINST SPRING FROSTS

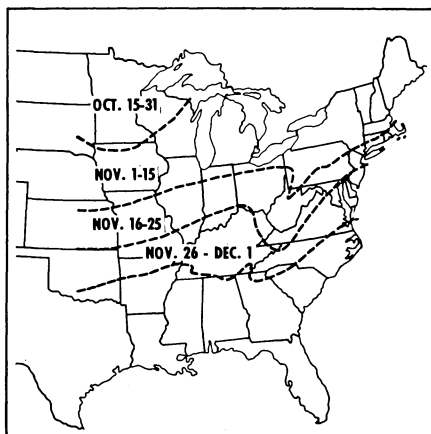
Strawberry plants must be protected against frost damage while they are flowering. This protection is usually provided in one of three ways:

- Using mulch.
- Operating sprinkler irrigation system.
- Burning smudges.

If the field has been mulched, and the mulch removed from the rows to the alleys, simply rake it back over the plants again if a freeze is expected.

If a sprinkler irrigation system is available, it can be used to protect plants against temperatures as low as 22° F. Get the system in position and test it if such an operation is anticipated. Begin sprinkling as soon as the temperature at the plant level drops to 32°. Continue until higher temperatures return and all ice has been melted off the plants by the irrigation water.

Use small nozzle tips on the sprinkler heads to avoid getting too much water on the soil. Space the



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Figure 13.—The best mulching dates for the areas outlined by broken lines usually are in the range of dates shown for the areas. Dates are not given for some of the southernmost areas to which this bulletin applies because winter temperatures normally are not low enough to hurt plants.

heads at 60 by 80 feet, or 80 by 80 feet if sufficient water pressure is available. Use sprinkler heads that rotate one revolution per 12 to 20 seconds.

Smudging and heating the plantation are other frost protection methods but are less effective than sprinkler irrigation. If heaters are used, 100 per acre will be needed when the temperature drops to 26° F. at the level of the plants. If smudge fires are used, build many small ones throughout a flat plantation. Build them at the lower sides of a plantation on a slope.

INSECTS AND DISEASES

Growers should familiarize themselves with insect enemies of strawberries that are likely to occur in

their localities, and thus be able to recognize and combat them as soon as they are discovered.

Information on insect control appears in USDA Farmers' Bulletin 2184, "Strawberry Insects . . . How To Control Them."

Growers should keep in close touch with the experiment stations in their own States, and upon discovering unfamiliar insects should send specimens to the stations or to the U.S. Department of Agriculture for examination. Early recognition of an insect in a locality may make it possible to apply control measures that will prevent a serious outbreak.

Information on disease control is given in USDA Farmers' Bulletin 2140, "Strawberry Diseases."

CHEMICAL WEED CONTROL

Herbicides control weeds effectively and economically. Good results, however, depend on using herbicides correctly—

- Do not use them on fields grown primarily for planting-stock production.
- Do not use more than one of them unless instructions specify that more are recommended.
- Test them on a small area before using them on a large scale.
- Make treatments when conditions are best for plant growth and weed seed germination.
- Apply them only when strawberry plants are in vigorous condition.

- Apply them at rates recommended by the manufacturers as stated on the label.

Rates of application in the following recommendations are for herbicides only—use the quantity of water recommended by the manufacturer. Usually the required amount of water will be 10 to 40 gallons per acre.

Late Spring and Summer Weeds

Herbicides that are proving useful in strawberry plantings are sesone, DCPA, diphenamid, and simazine. These herbicides are applied to the soil, where they kill germinating weed seeds. They do not kill established weeds.

Sesone kills germinating seeds of broad-leaved weeds and seeds of grass weeds such as crabgrass, foxtail, goosegrass, and barnyard grass (fig. 14). Apply sesone in a broadcast spray at 3 to 6 pounds per acre. In new plantings, begin treatments 2 to 3 weeks after transplanting. Do not apply sesone on established fields until after renewal operations. Cultivate before applying sesone. Repeat treatments every month if necessary to control weeds.

If you use DCPA, apply it as a broadcast application in spray or granular form at 9 pounds per acre immediately after transplanting, or after careful cultivation that removes all growing weeds in established strawberry plantings. This herbicide is most effective in controlling annual weedgrasses and also controls a number of annual

broadleaf weeds. A single treatment controls weeds for the entire growing season. DCPA should not be used during the flowering or fruiting periods of the strawberries.

If you use diphenamid, apply it as an overall treatment at the rate of 6 pounds per acre 2 to 6 weeks after transplanting. Do not harvest berries within 1 year after treatment. This herbicide kills most germinating annual weedgrasses and some broadleaf weeds.

If you use simazine, apply it at the rate of 1 pound per acre. It controls many annual weedgrasses and broadleaf weeds in strawberry plantings, but it cannot be used on light sandy soils, and its use is restricted to specific geographical

areas listed by the manufacturer on the container label.

All herbicides should be used cautiously on new strawberry varieties until experience has shown that the varieties are tolerant of the herbicide under local climatic conditions and cultural practices. Because herbicide performance is affected by these local factors, follow directions on the labels carefully.

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.



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Figure 14.—Sesone prevented germination of weed seeds in the plot at right. Crabgrass, goosegrass, foxtail, lambsquarter, pigweed, and other weeds infested the untreated plot at left. Neither plot was cultivated after runner production started.

Winter and Early Spring Weeds

To kill winter and early spring weeds such as chickweed, henbit, annual weed grasses, and vetch, use a mixture of 2 pounds of sesone and 1 pound of CIPC per acre.

If a straw mulch is used, a single herbicide application is recommended. Apply it either before or immediately after mulch is put on the field. Ordinarily, an application over the mulch controls not only the winter weeds but also the early spring weeds as they germinate.

If a mulch is not used, two applications may be required—one in early winter to kill winter weeds as they germinate, and one in late winter for the spring weeds.

For autumn plantings, wait 14 to 21 days after transplanting before applying herbicides.

RENEWING PLANTATION

The root system is often weakened while the fruit crop is maturing, and by the end of the fruiting season the root system may be incapable of properly supporting the top growth. In some plantations the vigor of the plants can be restored by removing the tops, fertilizing, cultivating, and eliminating weeds. These operations are called renewing the plantation.

Renewing as an alternative to replanting may or may not be profitable; it depends on such things as the variety being grown; weed, insect, and disease infestation; and the character of the soil.

Plantings of varieties that produce their largest crops the first year after setting may not be worth renewing—it is usually more profit-



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Figure 15.—Tops of the plants at right have been mowed; other renewal operations, such as thinning and turning under mulch, will follow.

able to plow up the fields and set new plants. Renewing often pays on plantings of varieties that yield bigger crops the second and third year after setting than the first year.

If you decide to retain the plantation, renew it—do not permit the harvested plants to continue growing without mowing the tops, cultivation, and thinning.

Some varieties—Pocahontas is an example—yield large crops for a number of years, and it may be more profitable to maintain such plantings for several years than to plow them up and start a new planting.

Regardless of the variety grown, it may be necessary to plow up the plantation after the first year if there is a heavy infestation of weeds that are difficult to control—weeds such as white clover, purslane, perennial grasses, and crabgrass. Serious disease and insect infestations may be other good reasons for starting a new field or planting a rotation crop instead of renewing.

Ordinarily, the cost of renewing a planting is less than the cost of establishing a new field.

Cutting the Tops

Cutting off the tops of plants is the first step in renewing a plantation (fig. 15). Fields of plants trained to the matted-row system usually are mowed by machine; fields of plants trained to the hill system usually are cut off with a scythe, sickle, or hoe.

In the North, where the growing season is short, mow the foliage as soon as the crop has been picked.

Where the growing season is longer, the mowing may be delayed for 2 to 3 weeks.

Turning Under

If injury from insects and disease is not serious, turn under the mulch and leaves. This will increase the amount of organic matter in the soil and put it in good tilth. When the mulch is very heavy, remove part of it before turning under. If it is not too much decayed, this mulch may be stacked for future use.

Burning Leaves and Mulch

If insects and foliage diseases are prevalent, burn the foliage and mulch in the field. Plants of some varieties are easily damaged if the burning is done in the rows. To avoid injuring delicate plants rake all the material into the alleys between the rows before burning. If the ground is very dry or if the material to be burned is damp, burn between rows regardless of variety. Burn when a breeze is blowing in the direction in which the rows run; start the fire on the windward side. This way, the fire will pass quickly.

Thinning the Plants

If you grow plants in matted rows, you probably should thin them when the plantation is renewed. Omit thinning only if you grow varieties that produce very few runner plants. No thinning is needed with the hill system or the spaced-row system.

Plants in matted rows should be thinned to 6 to 8 inches apart after

renewing. Most of the excess plants can be removed by running a spike-toothed harrow once or twice across the rows and then once down the rows. This tears up the weaker plants and levels the ridges made by plowing up the rows. Further thinning—if required—may be done with a hoe.

The crowns of the thinned plants are usually covered with an inch or two of soil. Within 2 or 3 weeks the plants will grow new foliage.

PRECAUTIONS

Herbicides used improperly may cause injury to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Keep herbicides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them.

When handling a herbicide, wear clean, dry clothing.

Avoid repeated or prolonged contact of herbicide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of herbicide dusts or mists.

Avoid spilling herbicide concentrate on your skin, and keep it out of your eyes, nose, and mouth. If you spill any on your skin, wash it off immediately with soap and water. If you spill it on your clothing, remove clothing immediately and wash contaminated skin. Launder the clothing before wearing it again.

After handling a herbicide, do not eat, drink, or smoke until you have washed your hands and face. Wash any exposed skin immediately after applying a herbicide.

Avoid drift of herbicide to nearby wildlife habitats, bee yards, crops, or livestock.

To protect water resources, fish, and wildlife, do not contaminate lakes, streams, or ponds with herbicide. Do not clean spraying equipment or dump excess spray material near such water.

Do not apply herbicides to plants during hours when honey bees and other pollinating insects are visiting them.

Dispose of empty herbicide containers at a sanitary land-fill dump, or crush and bury them at least 18 inches deep in a level, isolated place where they will not contaminate water supplies. If you have trash-collection service, wrap small containers in heavy layers of newspapers and place them in the trash can.

It is difficult to remove all traces of herbicides from equipment. For this reason, do not use the same equipment for applying herbicides that you use for insecticides and fungicides.



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